IMPL... UICAL
4 DEC 1937
...STITUTE

U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1587

MUSHROOM CULTURE *for* AMATEURS

Vera K. Charles 1933.

UNITED STATES DEPARTMENT OF AGRICULTURE

SUCCESS in mushroom growing is largely dependent on the careful study of the peculiar requirements of the crop and the faithful adherence to well-established methods. Carelessness and inattention to details have no place in successful mushroom cultivation, but careful attention to securing suitable buildings, good manure, and pure spawn should meet with success.

A large initial expense is not necessary and is, in fact, unwise. The time to expand is after some experience has been acquired and a knowledge gained of the best way to do things, as governed by the facilities or limitations of the individual grower. Often unused buildings, cellars, or basements may be conveniently adapted to mushroom growing and expense saved.

Keen satisfaction is attendant upon the successful production of any crop, and an added pleasure is experienced by the amateur in witnessing the appearance of this semimysterious crop.

The many cases of successful mushroom growing by those who have practiced the methods explained in this bulletin suggested its preparation.

Washington, D. C.

Issued March, 1929
Slightly revised September, 1933

MUSHROOM CULTURE FOR AMATEURS

By VERA K. CHARLES, *Associate Pathologist, Division of Mycology and Disease Survey, Bureau of Plant Industry*

CONTENTS

	Page
Introduction	1
Nature of the mushroom	3
Occurrence of poisonous or other fungi in mushroom beds	5
Where mushrooms may be grown	5
Buildings for mushroom growing	6
Use of old buildings and cellars	7
Greenhouses	7
Ventilation	8
Manure	8
Composting	8
Manure substitutes and supplements	10
Beds	10
Spawn	11
Casing	12
Growing period	13
Picking	13
Duration of crop	13
Marketing	14
Diseases and insects	14
Nutritive value of mushrooms	14
Summary and conclusions	16

INTRODUCTION

THE high esteem in which mushrooms have been held as an article of diet dates back to ancient times. They have always been considered more or less of a delicacy, an extravagance, "a food fit for the gods," and not a dish for the average table. However, with the increased production which has taken place in the last few years they are becoming more reasonable in price, so that they need no longer be considered solely as a luxury.

Although commercial mushroom cultivation in North America is confined to a comparatively small number of growers, many people are interested in producing mushrooms for home consumption, or commercially to a limited extent. It is for this class and for the amateur grower, that this bulletin is especially intended. The object is to give the prospective grower a knowledge of the requirements of the crop, to assist him in starting in an economical way by using buildings already erected if easily adapted to the purpose, and in other ways avoiding undue expense until he has gained experience and an understanding of the peculiarities of the crop. In view of the peculiar requirements of mushrooms, it is best to begin in a small way and with a limited financial outlay unless the prospective grower has had some experience with this crop. Since there are no colleges or other institutions giving instruction pertaining to this subject, the new grower is generally forced to learn from personal experience. Apprenticeship with an established firm is very desirable but generally difficult to arrange.

Mushroom cultivation has long been shrouded in an air of mystery. This is due principally to two causes: (1) The crop is grown under such apparently unnatural conditions, for example, lack of sunshine or even light, so essential to most crops; and (2) the necessity for manure instead of ordinary soil, such as is required by most crops. Again, books on the subject of mushroom cultivation are very few, and successful growers have gained their knowledge largely from their own experiences and ofttime failures. Naturally, a free discussion of the business is not to be expected. Most plants, if a cer-

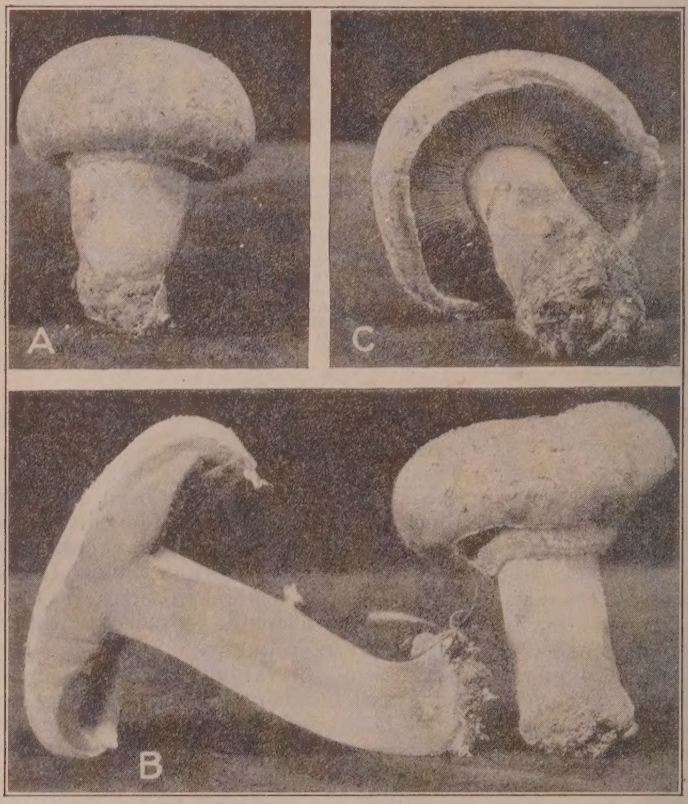

FIG. 1.—Development of mushrooms from the button stage (A), through the ring-breaking stage (B), to maturity (C)

tain measure of attention is given to their needs, such as water, light, and suitable soil, will react in proportion to the attention given, but mushrooms are very temperamental and exacting in their requirements. Drafts or uncongenial temperatures, even for a very short time, will often check or seriously injure a developing crop.

For successful mushroom growing most careful attention must be given to the three following points: Good manure, pure spawn, and a constant given temperature. Indifference or neglect of any one of these essentials will result in failure.

NATURE OF THE MUSHROOM

The cultivated mushroom, technically known as *Agaricus campestris*, belongs to a group of plants classed as fungi. These plants are characterized by the absence of green coloring matter, which, with the addition of sunlight, enables higher plants to form their own food, namely, starch. It is this fact, the nonmanufacturing phenomenon, which enables mushrooms to develop in the dark. In England mushrooms are grown very commonly in the light, but in the United States this is done only to a very limited extent and not commercially. Growing mushrooms in dark buildings is more a matter of economy than of providing conditions essential to successful mushroom cultivation.

The parts of a mushroom may be described as follows: The cap or pileus (fig. 1), the expanded, umbrellalike portion at the top;

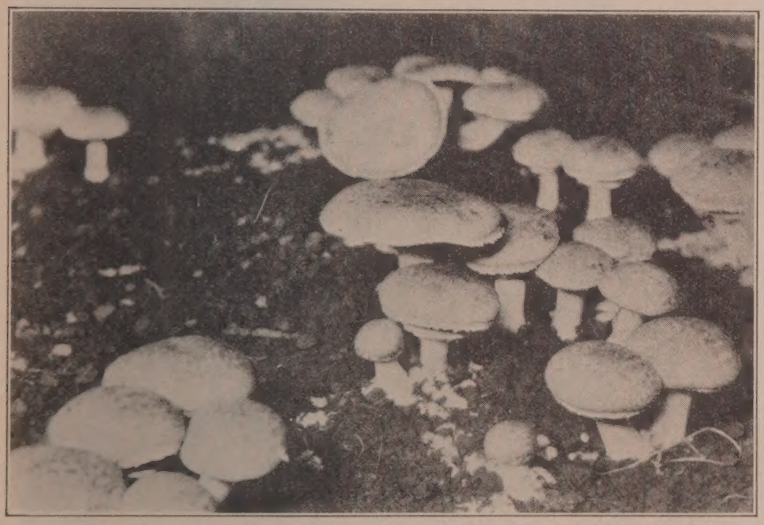

FIG. 2.—The cultivated mushroom (*Agaricus campestris*)

the stem or stipe, bearing the cap; the gills, the platelike folds on the lower surface of the cap, on which the spores are borne; the spores, which are minute, microscopic bodies, similar in function to seeds; the ring, a membranelike structure, which in the young condition covers the gills and reaches from the margin of the cap to the stem; the mycelium, known in the trade as spawn, being the white, more or less thickened, threadlike to cordlike strands which run through the beds and from which the mushrooms develop. In a sense the mycelium corresponds to the roots of higher plants.

There is considerable variation in the color of the cultivated mushroom, due to the fact that there are several different varieties on the market, ranging in color from dark tan to snow white. This variation in color applies to the cap and stem only. In ordering spawn the color of the mushroom desired should be specified. The color

has little to do with the esculent quality of the mushroom and is largely a matter of individual taste. If mushrooms are to be sold on a commercial scale, color is an important consideration, because some markets demand white or light-colored mushrooms, while other markets will accept only a light-brown or tan mushroom. The gills

FIG. 3.—*Coprinus* sp., a fungus often appearing in mushroom beds

in the cultivated mushroom are always pink when young and turn brown as they mature. Great care should be exercised to determine whether the gills are pink in the young condition, as certain poisonous species have persistently white gills and might be mistaken for the commercial mushroom.

OCCURRENCE OF POISONOUS OR OTHER FUNGI IN MUSHROOM BEDS

It is quite possible for poisonous species of mushrooms to appear in beds of the cultivated mushroom. Although this may not happen often, the grower should be so familiar with the commercial mushroom (fig. 2) that he can instantly detect any wild species. Spores or mycelium of other varieties of mushrooms may be introduced in the manure used for making the beds or in the soil used for casing. Casing is the term applied to the shallow layer of soil added after the beds have been spawned and the spawn has begun to run.

One very common wild mushroom which often develops in freshly prepared beds is a species of Coprinus. (Fig. 3.) This mushroom is umbrella shaped, grayish or silver white in color, with gills soon turning black. The whole plant becomes soft and watery and appar-

FIG. 4.—One of the cup fungi (*Aleuria vesiculosa*)

ently melts away. This species occurs more or less abundantly, singly or in clusters, and often covers areas of considerable size in mushroom beds. Its natural habitat is manure piles, which are the common source of its introduction. These plants are seldom injurious and ordinarily disappear in a few days. Another fungus frequently making its appearance in mushroom beds is one of the cup fungi. (Fig. 4.) This may appear in considerable quantity, and although not poisonous it is not particularly good.

WHERE MUSHROOMS MAY BE GROWN

Mushrooms, unlike other crops, may be grown in any locality in which the proper conditions of temperature and humidity are provided. This may necessitate artificial heating or refrigeration, de-

pending upon the section of the country in which mushroom cultivation is contemplated. The wide geographical range of growth is largely explained by the fact that manure is the medium on which mushrooms are grown. In contrast to the wide geographical range where mushrooms can be grown is the limited range of certain other crops. This limited range is due to the special soil requirements of these crops in such geographical locations. With most crops another important factor is climate; for example, certain crops need periods of cold for dormancy, while others require long periods of heat, without extreme cold, for their development and fruition. Of course, in growing mushrooms the geographical location has a bearing, in that the proper temperature must be maintained, and if either extreme of heat or cold is present great trouble and expense will be required to provide and maintain the desired temperature. Certain large

FIG. 5.—Modern mushroom houses

growers located in sections too warm for successful mushroom growing, or others wishing to prolong the growing season, resort to artificial cooling in order to maintain the desired temperature.

BUILDINGS FOR MUSHROOM GROWING

In contemplating mushroom growing, one of the first things to be considered is a suitable place or building. Very often a cellar, a basement, or an idle building may be easily adapted for the purpose. In connection with growing mushrooms in a cellar or any part of a dwelling the question is often asked as to the possibility of an objectionable odor from the manure. This difficulty will not be encountered if the manure has been properly composted.

Later, after an understanding of the needs of the crop is acquired and a continuation of the business on a commercial basis is planned, special houses may be erected. These may be built of tile, cement, or brick. Hollow tile is very satisfactory but more expensive than

wood, and unless the business is well established, that is, past the experimental stage, the expense would not be justified. There will always be a tendency to excessive moisture in houses built of these materials, but it may be corrected by providing a steep double-walled roof with air spaces between the walls.

Figure 5 shows a group of modern mushroom houses and a protected shed for the manure. It will be observed that the area in front of the houses is concrete, which facilitates the practice of sanitary measures. After the manure from old beds is removed this space may be swept and thoroughly sprayed with formalin. The proximity of the railroad facilitates the direct removal of old manure, thus lessening the danger of distributing the spores of injurious fungi which might be present in the manure.

USE OF OLD BUILDINGS AND CELLARS

In utilizing an old building, a convenient means of entrance and exit wide enough for the easy passage of wheelbarrows containing manure or casing soil is an important feature to be provided. Care must also be taken to prevent drafts. If cracks are present in the building they should be plugged before filling the house. In some cases a vestibule may be easily arranged, so that where extremely cold temperatures prevail the possibility of a sudden cold draft when the doors are opened is prevented. In many cases a cellar or basement may be used for growing mushrooms. If a furnace is in the same compartment, it may be necessary to build a partition or to cover the furnace and pipes with asbestos in order to maintain as low a temperature as is desired. On the other hand, if the basement or cellar is very large or cold, heating pipes may be run from the furnace to the mushroom section. Sometimes oil stoves may be conveniently used. In any event the important point is to maintain an even temperature of about 55° F. during the growing and bearing period. While 55° is the most favorable temperature for mushroom growing, the safety zone is between 50° and 60°. A high temperature is more to be feared than a low temperature.

In addition to cellars, basements, or old buildings for growing mushrooms, caves, abandoned mines, ice houses, or breweries can be used. In caves or mines especial care is required to provide a suitable ventilating system.

GREENHOUSES

In England greenhouses are utilized extensively for mushroom growing, the entire floor of the house being used for the purpose. This practice is followed to a limited extent in the United States, but only the space under the benches is utilized for the purpose. One great danger in greenhouse culture is the liability to sudden increases in temperature during sunny days. This danger is minimized in England by the preponderance of fog and the lesser intensity of the sun's rays. Greenhouses devoted to crops that require a fairly low temperature, such as violets, carnations, or lettuce, are best suited to mushroom growing.

124221°—35——2

VENTILATION

One of the very important factors in successful mushroom growing is to provide a satisfactory means of ventilation. In general, it should be remembered that the object of ventilation is to supply oxygen and provide a means of expelling carbonic acid gas, which is exhaled by growing plants. While a change or renewal of air is essential, great care to avoid drafts must be observed. Sudden changes of temperature check growth, causing darkening and cracking of the developing mushrooms.

Although no specific methods can be given for providing suitable means of ventilation where no particular type of house is used, the following few suggestions should be noted.

If a remodeled house or building is used for mushroom growing, the most satisfactory means of ventilation may be provided by outlets in the roof. There are several types of ventilators on the market, and the grower should be advised as to the model best adapted to his particular needs. Careful screening of ventilators is important to exclude insects, particularly when other mushroom houses are in close proximity. Where houses are small and windows are used for ventilation, the ordinary type of ventilator may be utilized, thus preventing drafts that would result from opening the windows without such provision. If one is unfamiliar with ventilating problems the advice of a good builder is often of value.

MANURE

With the introduction of the automobile, the necessity for horses began to diminish, and now the pronounced scarcity of horse manure is a serious menace to mushroom growing. The difficulty is not only in obtaining sufficient manure, but manure of good quality. Fresh manure is essential, and unless great care is observed in the selection of suitable manure, all other precautions are of no avail. The manure must be from grain-fed animals, preferably bedded with straw. Many instances of failure with mushrooms have been noted and traced to manure from animals fed a diet other than grain. In one case of almost complete failure it was found that the manure used was from animals to which sorghum had been fed. In another instance, failure resulted because the animals had been given alfalfa and molasses.

The high price of straw has led to the practice of bedding with shavings or sawdust. The use of these substitutes reduces the value of the manure for mushroom growing and increases the time and labor required for composting, especially if there is resin in the shavings.

If manure is purchased from a city cleaning department, its history should be investigated to ascertain whether or not it has been treated with chemicals. Often this is done to remove odor. Manure from veterinary stables is also often treated with chemicals which may render the manure unfit for growing mushrooms.

COMPOSTING

The collection, preservation, and treatment of manure have a most important bearing upon the compost and the value of the crop produced. The fermentation which changes the manure into compost

may be maintained and controlled by different methods. An attempt is made here to give simple directions that may be readily followed by the amateur, believing that after some experience has been acquired, there will be time enough to experiment in shortening or otherwise changing the process described.

An absolutely certain method of curing the manure is one of the grower's most serious problems, the variable nature of the material making it necessary at times to modify even well-established rules.

Manure in which plenty of straw bedding has been left should be selected, since the straw lightens the compost and tends to prevent sourness and sogginess where there is too much water. Beds having a sufficient proportion of straw bear longer than those deficient in straw. Too much straw is better than not enough. The manure as it is collected should be stacked under cover if possible, or at least it should be well protected from rain to prevent excessive wetness, especially at the time of making the beds. Great care should be observed to prevent loss from leaching, a condition resulting from allowing rain to percolate through the pile. When a suitable place has been selected for the composting, the ground must be cleared off and well sprinkled with pulverized quicklime or sprayed with a solution of formaldehyde consisting of 2 quarts of formalin to a barrel of water. A suitable location for a manure pile can not be found easily in a town or city, being usually forbidden by health ordinances.

The compost heap should be not less than 3 feet nor more than 4 feet high. If too low it will not heat enough; if too high it will become too hot and dry out. The length may be determined by convenience, but the width should be such that the manure can be properly handled. During fermentation the temperature should reach 140° to 150° F., the most satisfactory compost resulting when at some time during the process 125° has been constant for several days.

When forming the heap, the dry parts should be watered, taking care that the pile is wet throughout, but not drenched. The manure should be pressed into a compact mass, since great damage is often caused when it is piled so loosely that air gets into the interior. If the pile turns white in places (on the outside at the first), a condition known as burning or fire-fanging will result, causing considerable injury. Moist, well-packed manure does not firefang.

About six days to two weeks after the pile has been formed it should be thoroughly forked over by throwing the outside of the old pile to the center of the new heap, the center of the old pile thus becoming the outside of the new one. The manure should be well shaken and mixed, all dry spots watered, and about 2 inches of fine loam placed on the pile. The loam helps to prevent too rapid heating during fermentation as well as to hold the heat after the mushroom bed is made. This forking should be repeated twice, at intervals of about five days, loam being added each time. During the entire period the pile must be kept compact and firm. In about three weeks it should be suitable for making into beds. When the compost is ready for use it should be dark brown and moist, but not moist enough to leave water in the hand on compressing it.

MANURE SUBSTITUTES AND SUPPLEMENTS

At the present time there are no satisfactory substitutes or supplements for horse manure on the market. Various materials, including cottonseed meal, Thomas slag, commercial fertilizers, and peat, have been experimented with by growers and mushroom specialists with varying results. It would therefore appear to be sound practice for the amateur grower to confine his efforts to the use of horse manure compost until such time as definite experimental data is available on the use of other materials.

BEDS

Mushroom beds are of two general types, the flat bed and the ridge bed. The flat type is used exclusively if the beds are to be in tiers

FIG. 6.—Tiers showing flat beds of mushrooms

(fig. 6), and it is also used if the bed is made on the floor. The flat bed, when made on the floor, may be one continuous bed with raised plank walks running through the center and having side branches at intervals of 6 feet in order to permit cutting the mushrooms without stepping on the beds. Flat beds should be about 10 inches deep.

Ridge beds are used in caves or where floor space is not an economic consideration. (Fig. 7.) They are also used in outdoor cultivation. The beds should not be more than 2 feet wide at

the base and 15 inches high. They should be rounded, tapering gradually to the top. Between the beds, walks about 15 inches in width are found most convenient.

If the beds are arranged in tiers, the tiers may be from 2½ to 3 feet in height. If the building is very high and more than three or four tiers are desired it will be necessary to erect some kind of a walk or scaffolding to reach and prepare the beds conveniently.

SPAWN

One of the most important factors in successful mushroom cultivation is good spawn. No matter how carefully all other details have been observed, the use of poor spawn will result in failure. Names of firms claiming to manufacture only pure-culture spawn may be obtained by writing to the United States Department of

FIG. 7.—Ridge and tier beds of mushrooms

Agriculture, Washington, D. C. Spawn may be purchased from many of the large seed firms, but is not especially featured by them, nor are all varieties carried by them. Moreover, they do not sell enough to insure the quality. For these reasons, dealing direct with the manufacturer is more satisfactory and insures a fresh product. The manufacturers of spawn furnish several varieties, the most popular being Pure White, Cream, and Light Brown. The selection of the variety of spawn is a question of individual taste to be decided by the grower.

Spawn may be purchased in two different forms, brick spawn and bottle spawn. If fresh and properly prepared, either is good, but brick spawn dries out more quickly, and, being exposed, is in greater danger of contamination from molds. Spores of many different kinds of molds are ever present in the air, and if they happen to fall on a congenial medium, such as is afforded by the manure of brick spawn, they will germinate and grow, often covering the whole brick and greatly deteriorating its quality. Good bottle spawn

eliminates the danger of mold contamination or drying out. Information as to the quantity of spawn required for a certain area can be obtained from the manufacturer. One quart of bottle spawn is sufficient for 30 to 40 square feet.

One essential precaution in mushroom cultivation is to have the spawn on hand when the beds are ready to receive it. Late arrival of the spawn may cause considerable or entire loss of the crop, and delays which permit cooling off or drying out of the bed are often fatal.

After the beds have been made they should be tested daily by means of an ordinary or hotbed thermometer by inserting it in the bed to a depth of 5 to 6 inches. At first the temperature will rise to about 120° F., then after a few days it will slowly drop. Under no circumstances should the beds be spawned while the temperature is rising. Spawning should not be attempted until the temperature has dropped to about 65° or 70° F. Very fine crops have been known to result when the temperature has been 75°, but most successful growers advocate a temperature of 65°.

If brick spawn is used, it is advisable to lay the bricks on the bed a few days before spawning, especially if the bricks are very dry. Brick spawn should never be soaked before using, as such treatment is very injurious. The brick should be broken in 10 to 15 equal pieces and the pieces planted 10 to 12 inches apart and 1½ inches deep. Cover ¼ to 1 inch deep with manure and press firmly over the pieces of spawn. In using bottle spawn the contents of the bottle should be broken into about 45 pieces and planted about 1 inch deep, or not quite so deep as brick spawn. The manure should be pressed firmly over the pieces of spawn as with brick spawn. Many experienced growers advocate holding the beds at 60° to 70° F. for several weeks after spawning, claiming that this method will produce a much better yield. Under no circumstances should the beds be watered immediately after spawning, since watering is liable to cause the delicate threads of mycelium to rot and die.

If the compost has been properly cured the beds will contain a suitable degree of moisture, but if the atmosphere seems too dry the walls and aisles may be sprinkled, care being taken not to produce too great a degree of humidity.

CASING

Casing, as already defined (p. 5), is the layer of soil added after the beds have been spawned and the spawn has begun to run. The running of the spawn is indicated by a white moldlike growth developed from the pieces of spawn. If conditions are good, casing should follow about 10 days to 2 weeks after spawning. Soil for casing should be a light loam from pasture land or garden. This should be carefully sifted through a half-inch mesh sieve in order to eliminate lumps, stems, or other rubbish. Heavy clay loam should never be used, because it is not porous and consequently cakes or cracks. The soil for casing should be spread over the bed 1 to 1½ inches deep and tamped with the back of a shovel. The surface should be kept moist but never drenched. Some growers place clean straw over the beds to prevent rapid evaporation. If additional

moisture becomes necessary, watering with a fine rose spray will be found satisfactory. Sometimes cellars or ice houses in which mushrooms are grown are very wet and require special attention to overcome this difficulty. Often sawdust or shavings spread on the walks or placed in broad boxes will absorb the excess moisture and correct the trouble. These materials should be removed when they become saturated and fresh sawdust or shavings substituted.

Caution.—In a vicinity in which mushrooms have been grown, if any disease is present, especially that known as "bubbles," great care should be observed in selecting soil for casing. The use of manure and casing from spent beds for fertilizing other crops or gardens, practiced by many mushroom growers, has been a means of spreading the disease. In addition to contaminating the premises adjacent to the infected houses, wind and insects act as agents in carrying the spores of these diseases to points at very considerable distances.

GROWING PERIOD

Normally a mushroom bed should come into bearing in from 6 to 10 weeks from the time of spawning. If 10 weeks elapse without any appearance of mushrooms, something is wrong. The following causes may be responsible for the late appearance or nonappearance of mushrooms:

(1) Poor or weak spawn—foremost and impossible to correct. This is most discouraging, because no matter how carefully other conditions have been observed, poor spawn always spells failure.

(2) Poor or improperly fermented manure. This condition, like poor spawn, is impossible to overcome.

(3) If the temperature or humidity has been too low, mushrooms will be late in appearing; however, if these conditions are corrected a retarded bed may be brought into bearing.

(4) Failure may also result from spawning at too high a temperature. If soil used for casing contains too high a percentage of clay or too much sand, it is often responsible for the lateness or nonappearance of mushrooms. Some growers consider a dormant period advisable and maintain beds at a low degree of humidity for three or four months and then water them, in the belief that the yield is better in both quantity and quality. This method is practiced to a certain extent abroad, but if done by the amateur should be conducted on an experimental scale rather than as a general proposition.

PICKING

A mushroom bed that has come into bearing should be examined daily and the mushrooms picked before the membrane or veil extending from the end of the cap to the stem has broken. At this stage the mushrooms are known as buttons and command a better price than when larger or more expanded. Mushrooms may be picked by twisting the base of the stem. Care should be taken to press the soil over any holes made by picking mushrooms.

DURATION OF CROP

The duration of the crop depends largely upon the weather or the efficacy of the artificial control of temperature in the house and the general vigor of the crop. Under conditions where a high temperature can not be controlled, a sudden or continued warm spell may

be very injurious. Under normal conditions a mushroom bed should produce from three to six months. Commercial establishments often run much longer. With the aid of artificial refrigeration they may continue throughout the year.

MARKETING

If the grower has only a limited supply of mushrooms of which to dispose, he can do better by dealing direct with hotels, thus saving the expense for commission. The price of mushrooms varies greatly in different sections of the country, depending on the supply, which in turn is dependent upon the number of growers in a certain locality, or, in large cities, the quantity shipped in.

Mushroom production is subject to great variation, especially with amateur growers; consequently any contract made with a hotel or other concern should be more or less flexible or have certain limitations in order to protect the grower if he can not produce a given supply.

In preparing mushrooms for market, the stems should be cut off about an inch below the veil, and the mushrooms should be attractively packed in 1 pound pasteboard boxes or 3 pound wooden baskets. If wooden baskets are used they should be lined with tissue paper to prevent bruising the mushrooms. The necessity of avoiding all unnecessary delay in delivering the mushrooms to the consumer is to be emphasized.

DISEASES AND INSECTS

Mushrooms, like other crops, are subject to diseases and insects. The most serious and troublesome disease of the cultivated mushrooms is caused by a fungus and is known as "bubbles." This fungus causes the mushroom to become very much misshapen (fig. 8) and prevents its normal development. Sometimes an individual plant will become distorted, and again a whole clump of mushrooms will grow together, forming a shapeless mass. The diseased mushrooms are at first covered with a cottony growth, but at length they become brown and watery and emit a disagreeable odor. Beds showing any evidence of this disease should receive immediate attention, because after the disease becomes firmly established it is difficult to eradicate.

The various insect pests present a twofold danger. They not only eat or otherwise deface mushrooms, rendering them unsalable, but are active agents in carrying disease.

Directions for controlling diseases and insect pests are given in Circular No. 251.[1]

NUTRITIVE VALUE OF MUSHROOMS

Many extravagant claims have been advanced relative to the high nutritive value of mushrooms, but careful analysis does not support such assertions. However, mushrooms play a very important rôle

[1] LAMBERT, E. B. MUSHROOM GROWING IN THE UNITED STATES. U.S. Dept. Agr. Circ. 251, 34 p., illus. 1932.

as condiments or food accessories and as a flavoring add greatly to the palatability of many other foods. Their food value is increased by the addition of milk or butter often used in their preparation for the table. While mushrooms may be compared to certain vegetables, they are in no way a substitute for meat. They have no appreciable quantity of true protein, and although they contain some carbohydrate, it is not thought to be in a form that can be utilized in the body.

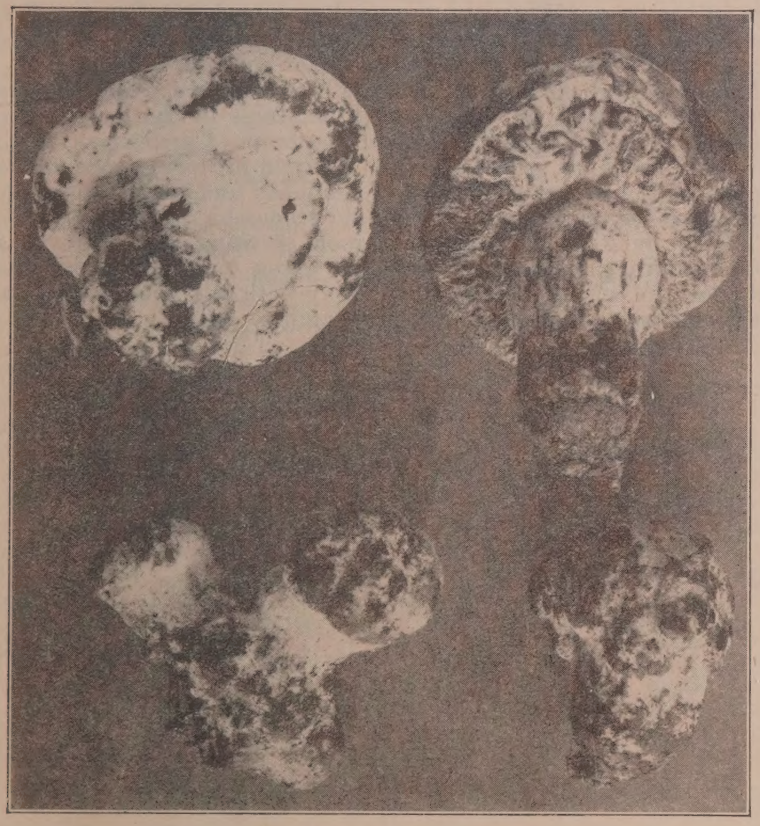

FIG. 8.—Specimens showing the mushroom disease called "bubbles"

Some experiments have been conducted relative to the presence of vitamins in mushrooms. While these studies have been limited in character and not at all exhaustive, mushrooms have been found to be a source of water-soluble B. It should be mentioned, however, that dried mushrooms were used for the investigation, and the degree of heat to which they were subjected was not mentioned. Further studies may reveal a more important vitamin content, but at present little is definitely known on the subject.

SUMMARY AND CONCLUSIONS

It is evident from the foregoing paragraphs that the prospective amateur grower may begin the cultivation of mushrooms with a small financial investment and with a fair assurance of success in return for patient, intelligent, and painstaking care. While amateur mushroom growing is not a source of certain and phenomenal wealth, it may reasonably be expected to yield a fair return for the capital invested and for the attention and labor required in the care of the crop. When the grower has gained experience and an understanding of the peculiarities of mushrooms, he may safely enlarge his business with the expectation of continued success.

Mushroom growing is distinctly a business that requires great aptitude for detail, exactness, and promptness in the execution of the work attendant on the care of the crop. Carelessness in the selection of manure, indifference and delay in procuring good spawn, neglect of the proper conditions of humidity and temperature, and lack of proper ventilation will not tend to success.

The formula for successful mushroom growing may be given as good manure, pure spawn, a constant given temperature, together with faithful attention to details. Only with this combination can the door to successful mushroom growing be opened.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	HENRY A. WALLACE.
Under Secretary	REXFORD G. TUGWELL.
Assistant Secretary	M. L. WILSON.
Director of Extension Work	C. W. WARBURTON.
Director of Personnel	W. W. STOCKBERGER.
Director of Information	M. S. EISENHOWER.
Director of Finance	W. A. JUMP.
Solicitor	SETH THOMAS.
Agricultural Adjustment Administration	CHESTER C. DAVIS, *Administrator.*
Bureau of Agricultural Economics	NILS A. OLSEN, *Chief.*
Bureau of Agricultural Engineering	S. H. MCCRORY, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Bureau of Biological Survey	J. N. DARLING, *Chief.*
Bureau of Chemistry and Soils	H. G. KNIGHT, *Chief.*
Office of Cooperative Extension Work	C. B. SMITH, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Entomology and Plant Quarantine	LEE A. STRONG, *Chief.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Food and Drug Administration	WALTER G. CAMPBELL, *Chief.*
Forest Service	FERDINAND A. SILCOX, *Chief.*
Grain Futures Administration	J. W. T. DUVEL, *Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
Bureau of Plant Industry	FREDERICK D. RICHEY, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Weather Bureau	WILLIS R. GREGG, *Chief.*

U. S. GOVERNMENT PRINTING OFFICE: 1935

For sale by the Superintendent of Documents, Washington, D. C. - - - - Price 5 cents